The ability to decode linguistic metaphors is a skill that develops relatively late, but the constitution on which such comprehension rests emerges in the first year.

Measures of Metaphor

Ellen Winner
Wendy Wapner
Michael Cicone
Howard Gardner

Introduction

Metaphorical extension of words is a central aspect of language. Almost all languages metaphorically extend physical terms to describe psychological states (for example, people are *cold, crooked, sharp, warm*); similarly, elements from one sensory modality are described by terms whose literal reference is to

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a different sensory modality (colors are *loud,* smells are *sharp*). Indeed, it is difficult to imagine how a language could fail to make use of metaphorical extension: not only does the possibility of metaphor allow an economical use of words, but it also directly reflects the ways in which we classify (and reclassify) the world. Paradoxically, although metaphors are often literally false, such language is sometimes the only way of capturing with precision the nuances of what it is that we want to express. By entering the nonliteral world of a metaphor, we emerge with a fuller grasp of the literal.

Adults readily process and make sense of the kinds of metaphors encountered in daily usage (Glucksberg, Hartman, and Stack, 1977). Hearing a memory described as cloudy, for example, an adult understands this to mean that the memory is unclear. However, describe a memory in this way to a six-year-old, and she will look puzzled and venture that perhaps you are talking about a memory of a cloudy day. Asked to explain what it means to describe someone as a piece of ice, an adult replies that the person is unfeeling or unkind. The six- or seven-year-old, however, may say that the person was magically turned into a piece of ice, or that he is holding a piece of ice. The eight-year-old may reply that an icy person is someone who is outside in the winter without a coat. It is not until they reach the ages of eight to ten that children begin to paraphrase such seemingly simple psychological-physical metaphors in a manner akin to the adult.

Understanding Psychological-Physical Metaphors

In our studies, we have attempted to determine just why such metaphors pose problems for young children. We have focused on three types of metaphor: psychological-physical ones, which are based on similarities perceived between an emotional state or characterological trait and a physical property (such as unkind person—ice); cross-sensory ones, based on similarities perceived between sensory modalities (such as loud sound—bright color); and visual ones, based on visual similarities in the physical properties of two objects (such as streak of skywriting in the sky—scar on the skin). Our studies have shown that even preschool children are rarely stumped by visual metaphors: They rarely take them literally and they understand them as does the adult. However, psychological-physical and cross-sensory metaphors prove much more opaque, and children misread cross-sensory metaphors in much the same way as they do psychological ones. But just why such metaphors should pose greater difficulties for young children is not clear.

In the present chapter we focus on the problems that children experience with comparisons between the psychological and physical domains. Our research is addressed in particular to the following question: Among unrelated languages, there is agreement about how these terms are extended, suggesting that human beings perceive nonarbitrary, abstract relationships between physical and psychological properties. Why is it that children fail to perceive such relationships when they are encoded in linguistic form?

Four Hypotheses

A number of hypotheses speak to the source of the difficulty:

1. Miscomprehension reflects unfamiliarity with one of the terms of the metaphoric comparison—psychological states—rather than a difficulty with metaphoric comparisons themselves.

2. Children encounter difficulties with such metaphors only when they are presented out of context and require that an appropriate context be imagined. If an appropriate context is supplied (through pictures, for example), comprehension should be enhanced.

3. Because of their metalinguistic nature, paraphrase tasks underestimate the child's level of comprehension. By using a nonmetalinguistic response mode that taps a more tacit, less explicit form of knowledge, comprehension should be located at an earlier age.

4. Even when children recognize that a psychological state is being described, they are at first only able to apprehend the general connotation of the metaphor: The overall polarity of the psychological dimension in question is apprehended before the dimension itself is grasped. Thus, children should understand that to describe a person as cold is to impute something negative about the person's character before they understand just which negative trait is indicated. Such a finding would confirm previous anecdotal reports (Winner, Rosenstiel, and Gardner, 1976).

A program of research was undertaken to test these four hypotheses.

Unfamiliarity with the Psychological? Hypothesis 1. In order to test our first hypothesis, we carried out a study in which, for a given item, first, second, and fourth grade children heard a brief description of a person and were then asked to select one of three phrases that matched the description. In one condition, the three phrases were psychological-physical metaphors (for example, a description of a bossy person was to be matched with *a bulldozer in a parking lot*); in the other condition, the three phrases were literal paraphrases of the metaphoric phrases (such as *a bossy person*). If difficulty with psychological metaphors simply reflects a difficulty in thinking and talking about psychological traits, children should encounter equal difficulty with both tasks. However, at all ages children proved able to select the correct literal phrases more often than the metaphorical ones ($p < .01$, $F = 99.85$, $df = 1, 30$). Thus, there appears to be a gap between children's understanding of psychological states and their comprehension of metaphorical extensions from the physical world to describe such states (Cicone, Winner, and Gardner, forthcoming.

In order to test the remaining three hypotheses, one large, multi-condition study was carried out. We constructed fifteen pairs of psychological metaphors representing opposite poles of fifteen psychological dimensions. For example, the following metaphors represented the extremes of the dimension *kindness: Jenny is a jagged piece of glass,* and *Jenny is a soft piece of silk.* The extremes of the dimensions were of two types—either positive-negative, as in the Jenny example, or active-inactive, as in the case of the dimension of *vigor* (for example, *Bill is a brand new engine,* versus *Bill is a broken down car*). The members of each pair were then separated into two lists (Forms A and B), each containing ten positive-negative items and five active-inactive ones. Seventy children in each of grades 1, 2, 4, and 5 participated in one of five conditions in which they received metaphors from either list.

Paraphrase. Children were asked to paraphrase each orally presented metaphoric sentence. This condition was included in order to be able to compare it to the hypothetically easier tasks that followed.

Picture Choice. Children were asked to match each metaphoric sentence to one of two pictures representing the two poles of the relevant dimension. For the two Jenny-metaphors, the pictures were a girl throwing an injured dog's dish of milk onto the ground and a girl feeding an injured dog. After selecting a picture, subjects were asked to paraphrase the sentence.

Story Completion. After hearing a brief story describing a particular situation, children were asked to complete (rather than paraphrase) metaphoric sentences—for example, "Jenny was on her way out to go to a party. As she walked out the door, she saw her brother sitting on the front steps with tears falling down his cheeks. Jenny was such a (a) *jagged piece of glass* or (b) *piece of soft silk* that she . . .".

Polarity-Action Choice. Children were asked to match each metaphor to one of two verbally described actions that the person named in the sentence might perform. The two actions reflected the two possible extremes (polarities) of the psychological dimension. For either of the two Jenny-metaphors, for example, the child was asked: "If Jenny's brother were crying, would she tell him to shut up, or would she give him a big hug?"

Polarity-Dimension Choice. Children were asked to match each metaphor to one of four verbal-characterological descriptions in which both polarity and dimension were systematically varied. For *Jenny is a jagged piece of glass,* the four choices were: correct—*She's nasty and grouchy;* wrong polarity—*She's nice and kind;* wrong dimension—*She never has an idea;* and wrong dimension/wrong polarity—*She has lots of ideas.*

Testing the Three Major Hypotheses

Does Pictorial Context Facilitate Comprehension? Hypothesis 2.

By comparing performance on the paraphrase condition to performance on the paraphrase measure of the picture-choice condition, the contribution of pictorial context can be assessed.

A four-way, condition (2) x age (3) x sex (2) x form (2), analysis of variance was performed on the total number of correct responses yielded by these two conditions. The ages tested were first, second, and fourth graders; fifth graders were not included in this analysis because, due to a ceiling effect in fourth grade, they were not given the picture choice condition. As predicted, a significant effect of condition was found (p<.0001, F=88.74, df=1, 60). Given the opportunity to first select a picture that matched the metaphoric sentence, the ability to paraphrase is dramatically improved. (In only three instances did a child select the wrong picture and then give an appropriate paraphrase. Correct paraphrases therefore indicate correct previous picture choices.)

Condition interacted with age (p<.0059, F=5.61, df=2, 60). Although scores improved with age in both conditions (p<.001, F=24.96, df=2, 60), performance on the pictorial-paraphrase condition jumped more dramatically between second and fourth grades than did performance on the unadorned paraphrase condition. When the paraphrase condition was analyzed across all four ages, the most dramatic leap in performance occurred between fourth and fifth grades.

Tacit Knowledge Before Explicit? Hypothesis 3. By comparing performance in the paraphrase condition to performance on the story-completion task, it should prove possible to determine whether a less metalinguistic response mode than paraphrase may reveal a more tacit, less explicit form of understanding.

A four-way, condition (2) x age (4) x sex (2) x form (2), analysis of variance was performed on the number of correct responses in these two conditions. As predicted, condition proved highly significant (p<.0001, F=211.97, df=1, 80), with performance drastically elevated in the story completion.

Performance on both conditions improved with age. Planned comparisons between ages revealed a difference between first and second grades (p<.0001, F=25.52, df=1, 80), between fourth and fifth grades (p<.0001, F=31.07, df=1, 80), and between first and second versus fourth and fifth (p<.006, F=7.99, df=1, 80). Planned comparisons were performed because it was predicted that the biggest leap in performance would occur between second and fourth grades. However, condition interacted with age (p_x.01, F=3.86, df=3, 80). Although story completion was easier for all ages, the difference between the two conditions was most extreme for first and second graders, least extreme for fifth graders. This was due to the fact that performance on the paraphrase condition improved the most between fourth and fifth grade; performance on the story condition improved the most at a younger age, between second and fourth grades.

A condition x age x sex interaction was also found (p<.01, F=3.75, df=3, 80). This interaction was due to a difference between fifth grade boys and girls: While girls of this age did well in both conditions, fifth grade boys performed at a much lower level in the paraphrase than in the story condition.

Finally, in the story condition, on six out of ten of the stories, children performed better when the stories ended with a positive metaphor than with a negative one because, regardless of whether stories ended with a positive or a negative metaphor, they tended to be given a positive ending. This proved true for metaphors representing such dimensions as kindness, helpfulness, and niceness, dimensions in which one polarity is clearly the more socially acceptable. This bias in favor of positive metaphors seems to have little to do with metaphoric understanding itself but may be due instead to the "good-boy" mentality documented by Kohlberg (1969) in the arena of moral development.

Polarity Before Dimension? Hypothesis 4. An examination of performance on the polarity-dimension-choice condition should reveal whether children are sensitive to polarity before being able to grasp the precise dimension. A comparison of polarity-dimension choice with picture choice and polarity-action choice should reveal the effect of response mode on children's ability to select the appropriate polarity. That is, are children more likely to indicate sensitivity to polarity if given a choice of adjectives describing static traits, a choice of verbal descriptions of actions reflecting psychological traits, or a choice of pictures portraying actions reflecting psychological traits?

A four-way, condition (3) x age (3) x sex (2) x form (2) analysis of variance was performed on the total number of correct responses on the polarity-dimension choice, picture choice, and action-choice conditions. (Scores were corrected to account for the fewer number of choices in picture and action choice. And, as in the first analysis described above, fifth graders were not included in this analysis since they did not receive the picture-choice condition.) As predicted, a significant effect of condition was found ($p<.0001$, $F=35.86$, $df=2, 90$). The polarity-dimension condition was the most difficult, the picture choice the easiest, with action choice in between. Thus the most sensitive measure of children's awareness of the polarity of a metaphor is the presentation of a choice of pictures portraying actions; selection of an adjective describing a static trait is the least sensitive.

Although a significant effect of age was found ($p<.0001$, $F=18.41$, $df=2, 90$), age interacted with condition ($p<.02$, $F=3.18$, $df=4, 90$). For first and fourth graders, the action-choice condition proved no easier than the polarity multiple-choice, although fourth graders performed significantly better than did first graders on both conditions. For second graders, however, the action-choice condition elevated scores to the level of those yielded by the picture choice condition. Thus, permission to select an action rather than a static characterological adjective has its most dramatic effect at the intermediate age level. At the first grade, the task may still be too difficult to make a difference; at the fourth grade, the polarity-dimension task may be sufficiently easy that children do not need an action response mode.

Turning now to performance on the polarity-dimension-choice condition alone, the number of correct choices improved with age. However, as predicted, planned comparisons between error types revealed that children of all ages made significantly more dimensional than polar errors ($p<.001$, $F=25.23$, $df=2, 39$) as well as more dimensional than totally wrong errors ($p<.0001$, $F=19.03$, $df=1, 40$). Moreover, across all ages, boys made more dimensional errors than did girls ($p<.03$, $F=5.33$, $df=1, 40$). Thus, understanding psychological metaphors appears to be a two-step process in which overall polarity is grasped before the precise dimension is apprehended.

We have seen that the conclusion one reaches about the capacity to comprehend psychological metaphors is a function of the measure used to assess comprehension. Lack of comprehension in the elementary school years is not due to an unfamiliarity with the psychological domain. However, the age at which one finds evidence of understanding depends upon whether a context is supplied or whether one must be generated by the child, as well as upon the response mode required. Moreover, understanding such metaphors involves grasping both polarity and dimension, two steps that develop not simultaneously but sequentially.

The Roots of Metaphor

We can now pose an additional question. What is the earliest point in development at which we can detect nonlinguistic evidence of metaphoric perception? Does failure on our linguistic tasks indicate a total absence of metaphoric skill prior to the elementary school years; or, by using different measures, can we locate the roots of metaphor at an earlier age?

We have already noted that preschool children demonstrate no difficulty in understanding visual metaphors. For example, asked to choose between three possible pretend names (metaphorical, anomalous, and literal) for a physical object, such as a green wooden block, three-year-olds select the metaphoric name 15 percent of the time, four-year-olds, 61 percent, and five-year-olds, 81 percent, after chance level performance is factored out (McCarthy, Winner, and Gardner, forthcoming; Winner, McCarthy, and Gardner, forthcoming). And, given a simple enough task, children can even effect cross-sensory metaphoric matches. Asked to match polar adjectives (such as *loud* and *quiet*) to nonverbal stimuli, such as color swatches, abstract lines, or pictured facial expressions, three- and four-year-olds performed significantly above chance—for example, a bright red color swatch and a jagged line were matched with *loud,* a pale blue swatch and a gentle line with *quiet* (Gardner, 1974). And finally, early language is replete with spontaneous metaphorical renamings. To cite just a few examples, a three-year-old pointed to freckles spotting her mother's arm and laughingly called them cornflakes; a four-year-old labelled a group of nuns dressed in their black and white robes as penguins; and another child of this same age playfully called a curled potato chip cowboy hat (Winner, forthcoming).

Rudimentary metaphorical capacities can thus be found at quite an early age. But we are still left with an unresolved question: What is the origin of the ability to effect and perceive metaphorical links? It is possible that metaphorical perception depends on exposure to conventional linguistic norms. That is, we may learn to connect bright colors with loud sounds or unkind people with thermal coldness only because this is the way that our language happens to make the connection—the link could as well have been bright to quiet, unkind to warm. But it is also possible that we are born with either a proclivity or an inherent capacity to perceive nonarbitrary similarities across domains. In the latter case, such a prelinguistic capacity would be the first manifestation of metaphorical skill and the ancestor of all later linguistic metaphorical capacities.

The fact that certain metaphors manifest themselves in unrelated languages is one piece of evidence in favor of the view that metaphorical matches are not arbitrary conventions but instead reflect primary ways of classifying stimuli. A stronger test of this hypothesis is needed, however, because we cannot be sure that the languages in question did not influence each other or derive ultimately from a common origin.

Through a study of infants, a critical test of this hypothesis is possible. If infants map elements from divergent sensory modalities in the same way as linguistic metaphors draw on such divergent modalities, the prelinguistic, primary, cognitive nature of metaphor will have been demonstrated.

Metaphorical Perception in Infants? In a study carried out in collaboration with Sheldon Wagner and Dante Cicchetti, we investigated whether infants were capable of mapping stimuli between the auditory and visual modalities (Wagner and others, 1979). Eight pairs of auditory stimuli were constructed, representing contrasting values along one dimension (such as a pulsing tone and a continuous tone). Eight corresponding pairs of visual stimuli were also constructed so that one member of each pair was judged by adults to match one member of the corresponding auditory pair. Thus, the visual stimuli matching the pulsing and continuous tone were a dotted and a continuous line respectively.

Sixty-one infants, ranging in age from 6 to 15 months ($\bar{x} \doteq 12$ months) participated in a visual preference paradigm. The infant, seated in front of a screen, heard an auditory stimulus (a_1)—such as the pulsing tone—presented for ten seconds. Three seconds after onset of a_1, the two visual stimuli corresponding to the auditory pair of pulsing and continuous tones were flashed on the screen, remaining there until termination of the auditory stimulus. Left to right presentation of slides was counterbalanced across infants. Sixteen seconds later, after one intervening stimulus triad, infants heard the other member of the auditory pair (a_2)—such as the continuous tone—and saw the same two slides.

The amount of time that infants looked at each slide was measured. Infants were given credit for a metaphorical match (MM) only if (1) the infant looked longer (by one or more seconds) at the visual stimulus judged by adults to match a_1; (2) the infant switched his visual preference upon presentation of a_2 and looked longer at the contrasting visual stimulus. Thus, the infant had to look longer at the dotted line when hearing the pulsing tone and longer at the continuous line when hearing the continuous tone. Reciprocal matches (RM) were defined as the reciprocal of an MM: Infants had to look longer at the continuous line when hearing the pulsing tone and longer at the pulsing line when hearing the continuous tone.

A Sign Test revealed that, on three of the possible eight matches, the frequency of MMs was significantly greater than that of RMs: pulsing/continuous tone—pulsing/continuous line, $p = .038$; pulsing/continuous tone—serrated contour/smooth contour, $p = .046$; ascending/descending tone—up arrow/down arrow, $p = .033$.

Thus, it appears that infants are able to dimensionalize values in one sensory modality in terms of the corresponding values of another modality. Such intersensory connections form the ground of many linguistic metaphors (such as a *high* tone, a *bright* sound). More importantly, however, the process of overriding boundaries between established domains and perceiving cross-domain similarities is the process that lies at the heart of all metaphorical operations. Thus, it appears that the capacity to perceive metaphorically—to override established links in favor of novel ones—is one of our birthrights. This finding lends strength to the hypothesis that metaphorical connections are not arbitrarily effected by our language; rather, the metaphors of language reflect certain universal modes of perception. Even if, as we have seen, the ability to decode complex linguistic metaphors takes many years to unfold, the basic constitution on which such understandings ultimately rest may be emerging during the first year of life.

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Ellen Winner, Wendy Wapner, Michael Cicone, and Howard Gardner form part of the metaphor research team at Harvard Project Zero. In addition, Ellen Winner teaches psychology at Boston College; Wendy Wapner and Michael Cicone conduct neuropsychological research at the Boston Veterans Administration Hospital; and Howard Gardner, codirector of Project Zero, combines his work on the development of symbolic capacities with research on the breakdown of these capacities in brain-damaged patients.